Update on changing role of resources and growth of utility scale storage

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G-PST RAG - Webinar Series

September 27, 2022

Robert Kott
Bio

- Operations Policy Manager, California Independent System Operator ("ISO")
- 35 years' utility experience
  - CAISO for 21 years: currently lead high level operational initiatives and represent the CAISO in technical forums; previously held management roles creating generation maintenance standards; managing local area reliability service process, reliability agreements, commercial model maintenance, regulatory contract implementation, resource adequacy implementation
  - Chevron Products Company for 3 years managing utility infrastructure projects to modernize and enhance the El Segundo and Richmond refinery electric utility distribution systems
  - Los Angeles Department of Water and Power ("LADWP") for 11 years in various engineering and management positions including Planning Engineer, Project Manager in the Generation Maintenance Department, Transmission Design Engineer, and Manager of Large Customer Contracts

- Education and Licenses:
  - BS Electrical and Electronics Engineering, California State University, Sacramento
  - MBA, Pepperdine University
  - Registered Professional Engineer in Electrical Engineering licensed in California

Agenda

- Current state of CAISO resources
- Expected future state of CAISO resource mix

Introduction with a few definitions

Integrated Resource Planning (IRP) is:

- A long term procurement process to plan for safe, reliable, and cost-effective electricity supply
- 10 year forward process

Resource Adequacy (RA) is:

- A procurement process to ensure that sufficient capacity is provided in the operational timeframe to ensure the safe and reliable operation of the electric grid
- Annual and monthly process (in California)

Drivers for the western region conversation on RA

- The region's bulk electricity system is in transition to lower GHG emissions
  - Goal: Greenhouse gas neutral generation by 2045
  - Orderly retirement of some gas resources
  - State's plan calls for
    - energy generation from renewable resources
    - Storage resources ensure energy deliverable to load
    - Increasing reliance on price responsive demand
- Load forecasts continue to increase and applies pressure to expand the pool of resources used to meet system needs

There are generally accepted elements of an effective resource adequacy program

- Forward planning study to determine a planning reserve margin based on an expected level of risk
- Periodic “showing” to assess whether sufficient capacity has been committed to be delivered across the expected transmission system to the forecast demand when needed
- Mechanism to encourage or enforce full coverage to avoid shortages or leaning on one participating entity by another
- Process to make all RA capacity available to the system operator(s) to meet demand needs under real time conditions

Current state of CAISO generation

Resources

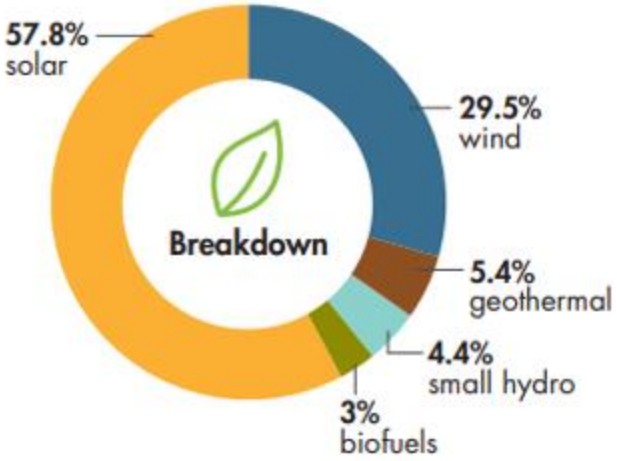
Resource adequacy net qualifying capacity (NQC) = **49,433 MW**

As of 09/01/22. Does not include current outages.

Installed battery capacity[4]
3,913 MW

As of 9/01/22; subject to change.

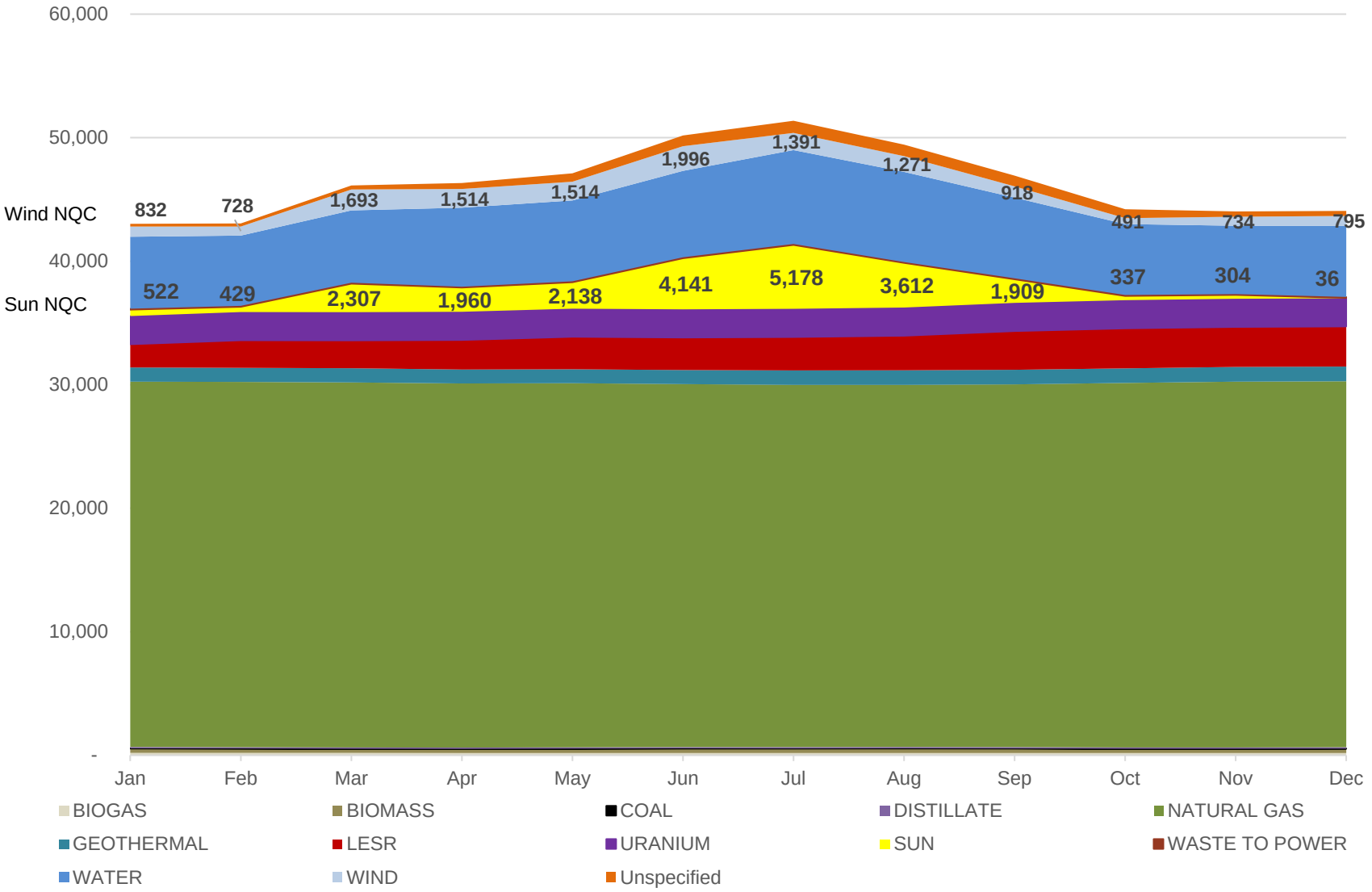
Installed renewable resources *(as of 09/01/2022)*



	Megawatts
Solar	15,608
Wind	7,956
Geothermal	1,465
Small hydro	1,182
Biofuels	804
TOTAL	**27,015**

See Today's Outlook

2022 Net Qualifying Capacity by Energy Source



CAISO Generation Statistics

Historical statistics and records *(as of 08/01/2022)*

Solar peak
14,352 MW
June 7, 2022 at 12:16 p.m.
Previous record:
14,136 MW, May 16, 2022

Wind peak
6,465 MW
May 28, 2022 at 5:39 p.m.
Previous record:
6,265 MW, Mar 4, 2022

Peak percentage of renewables compared to demand
103.5%
May 8, 2022 at 3:39 p.m.
Previous record:
99.87%, Apr 30, 2022

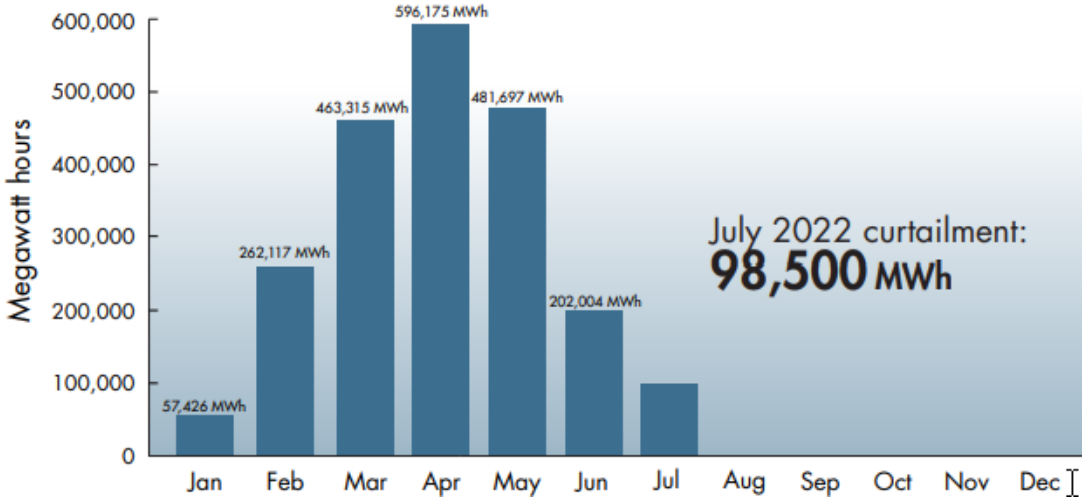
Peak net imports
11,894 MW
Sep 21, 2019 at 6:53 p.m.

Peak demand
52,061 MW Sept 6, 2022 at 4:58 p.m.
50,270 MW
Jul 24, 2006 at 2:44 p.m.
Second highest:
50,116 MW, Sep 1, 2017 at 3:58 p.m.

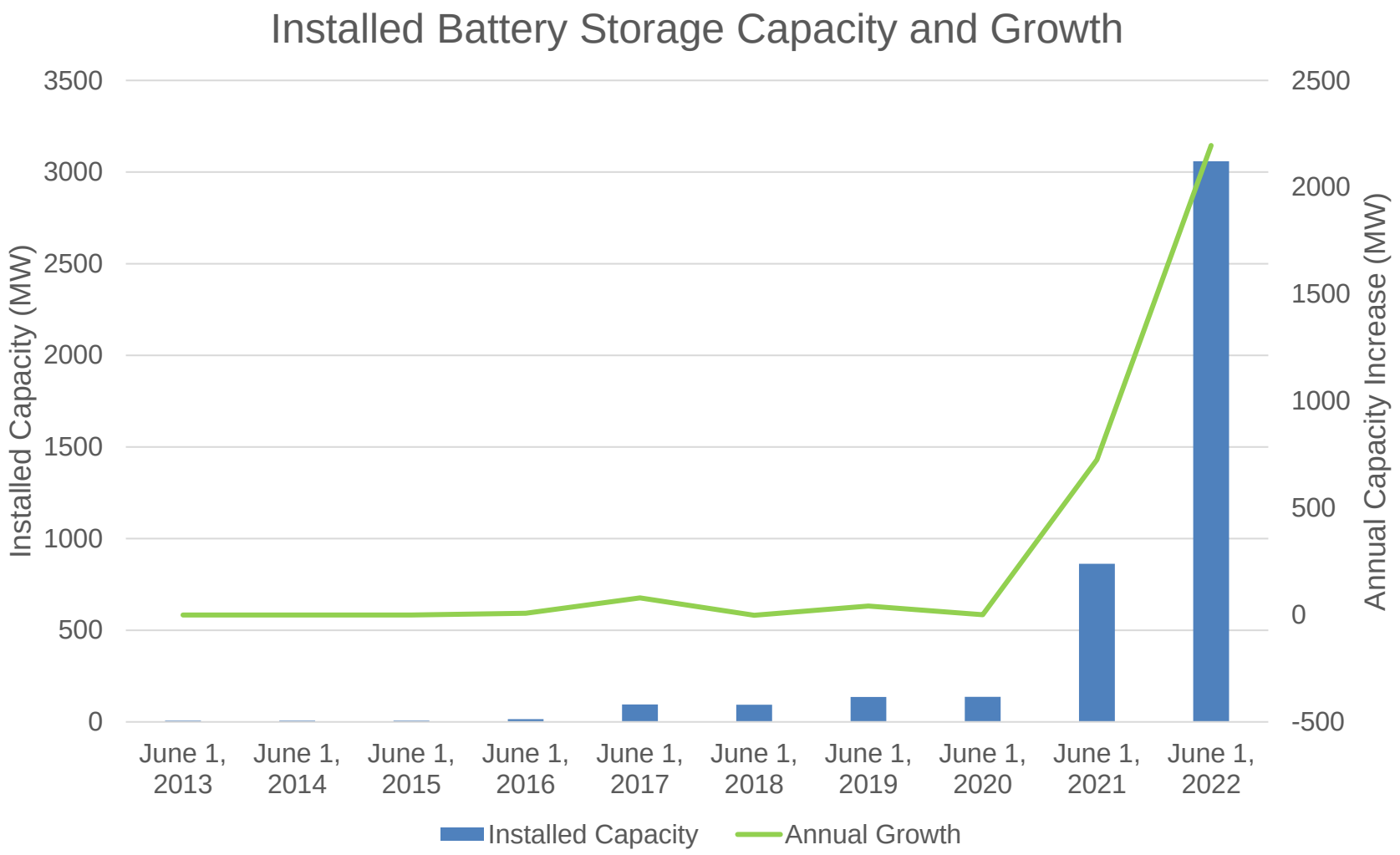
Steepest ramp over 3-hour period
17,660 MW
Mar 11, 2022 starting at 2:59 p.m.
Second highest:
17,298 MW, Apr 24, 2022

Wind and solar curtailment totals

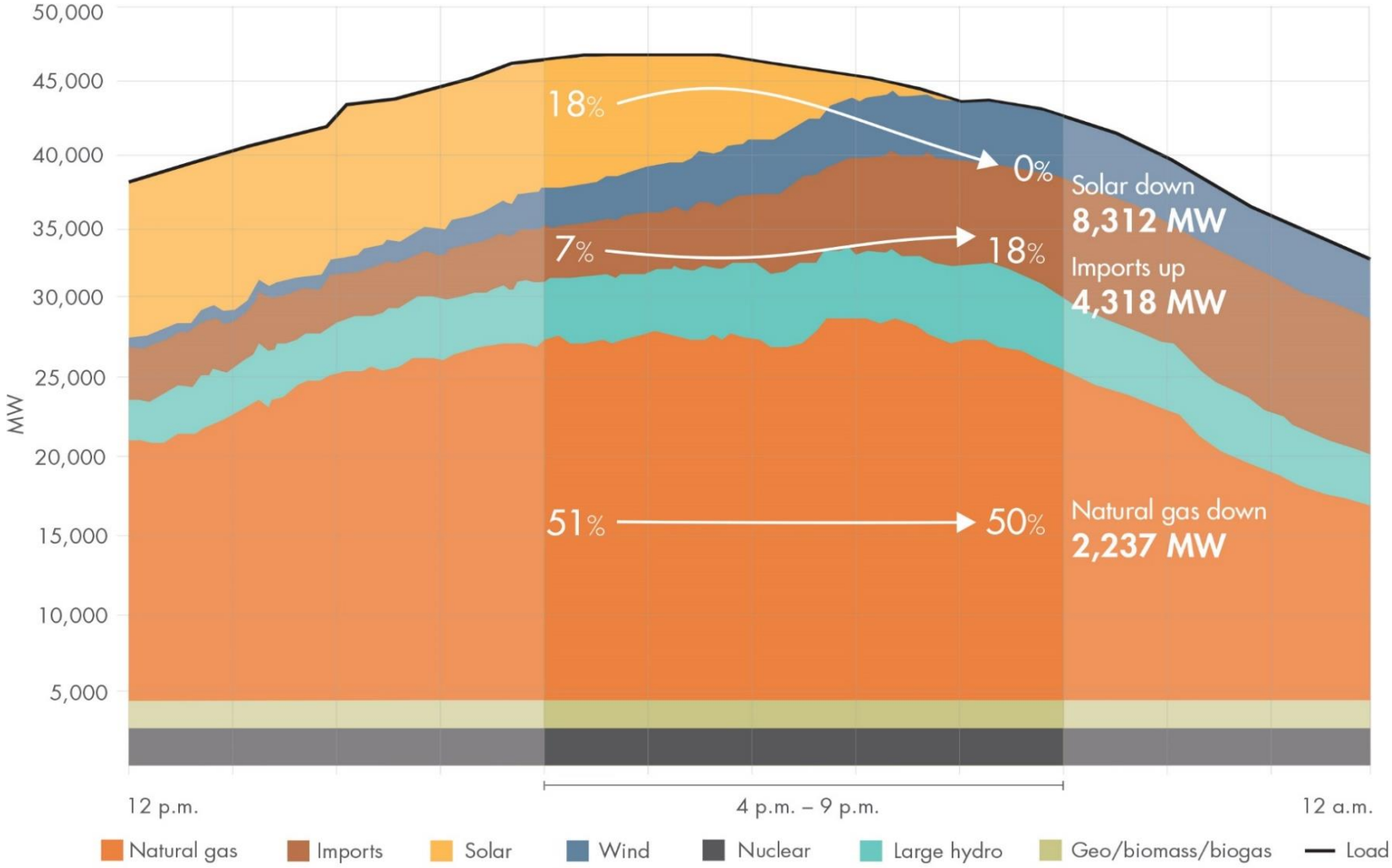
For more on oversupply, visit here.



Battery Storage and Growth



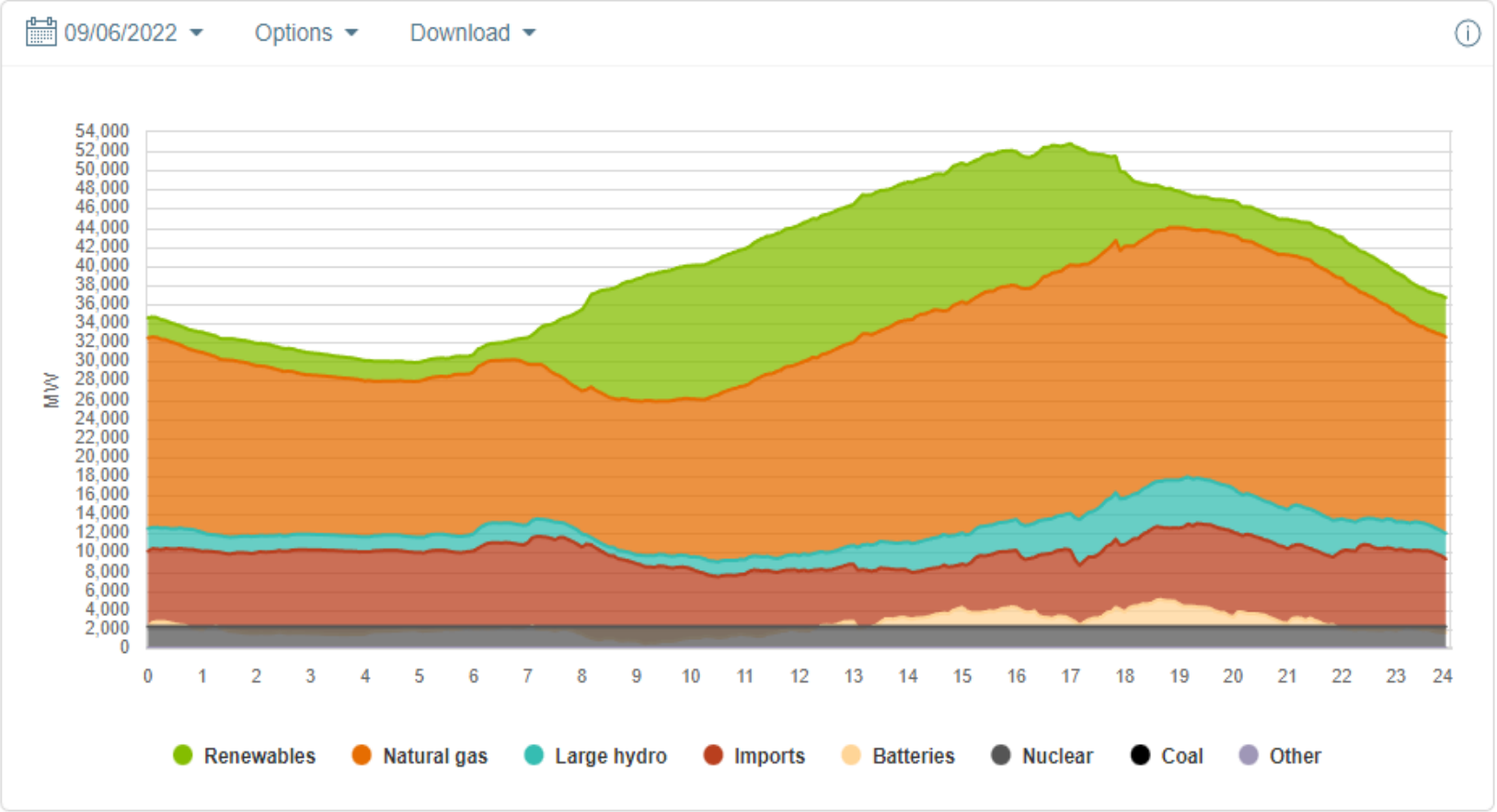
Conventional Generation is heavily relied up as solar is not available after sunset



Heavy Reliance on Conventional Generation and Imports after sunset

Supply trend

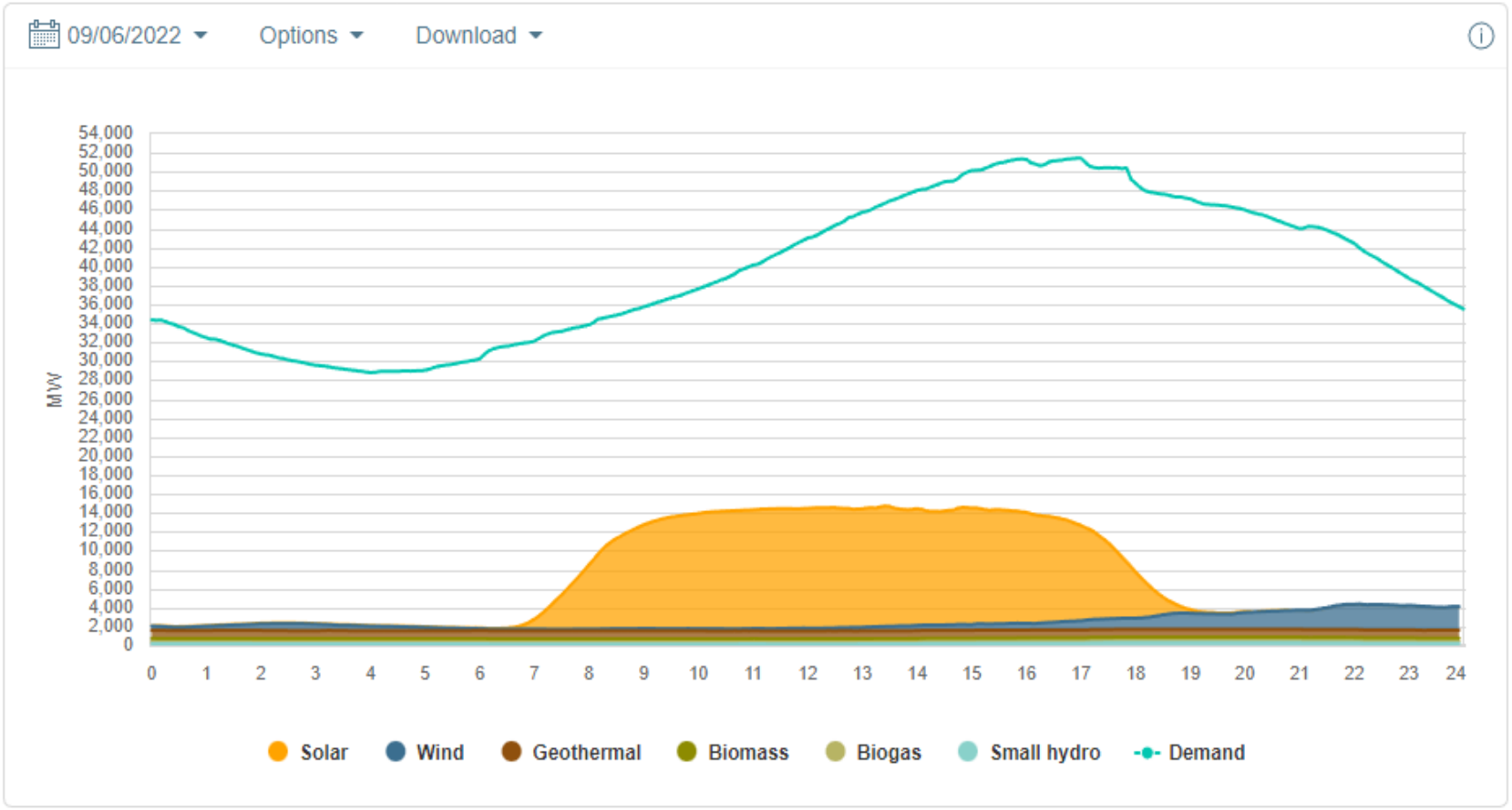
Energy in megawatts broken down by resource in 5-minute increments.



Solar Generation is the dominate renewable resource

Renewables trend

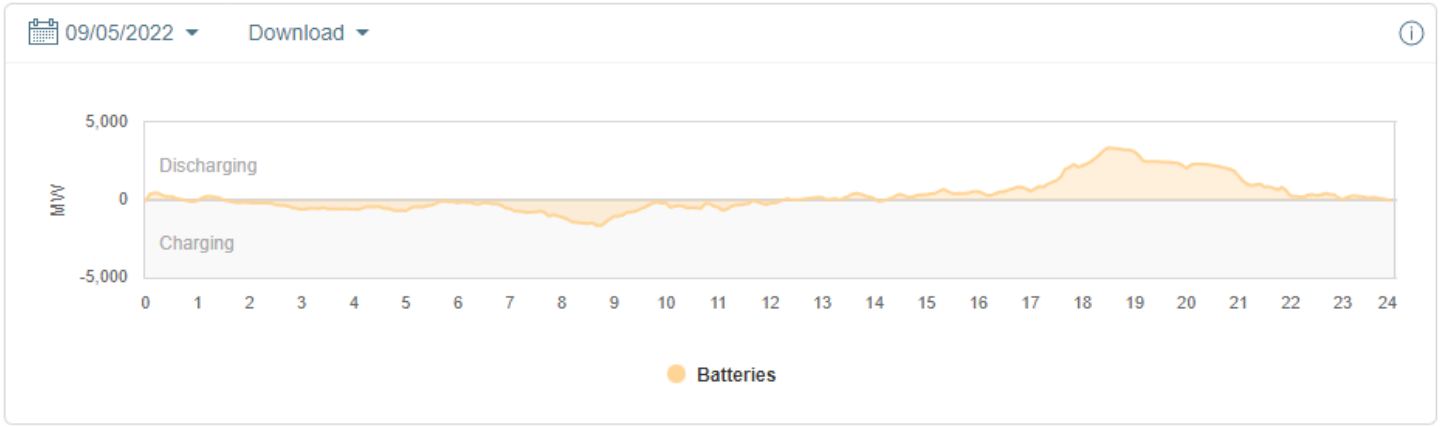
Energy in megawatts broken down by renewable resource in 5-minute increments.



Batteries and Imports provide significant support

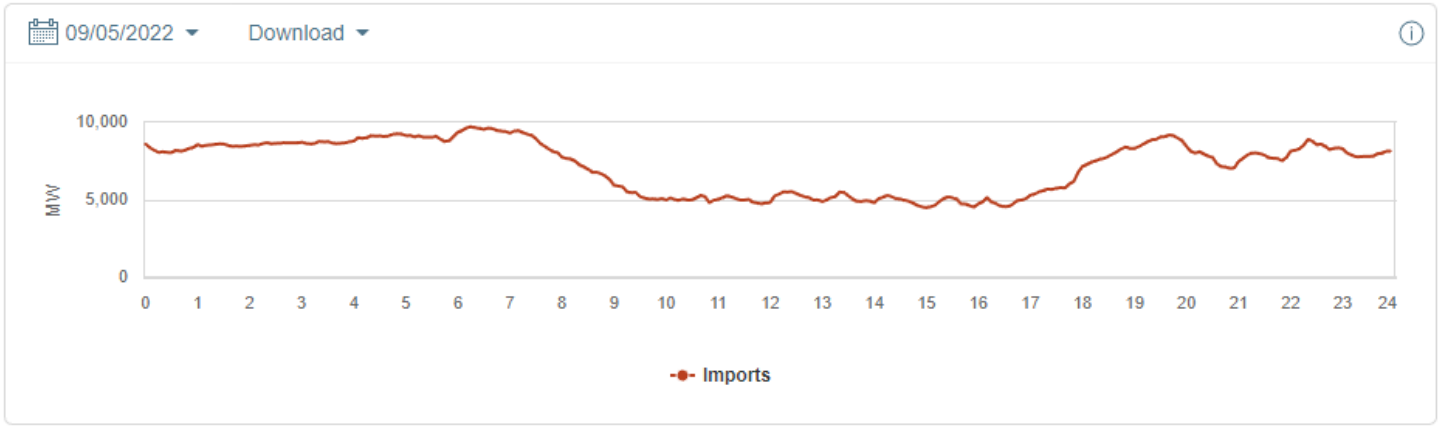
Batteries trend

Energy in megawatts in five-minute increments.

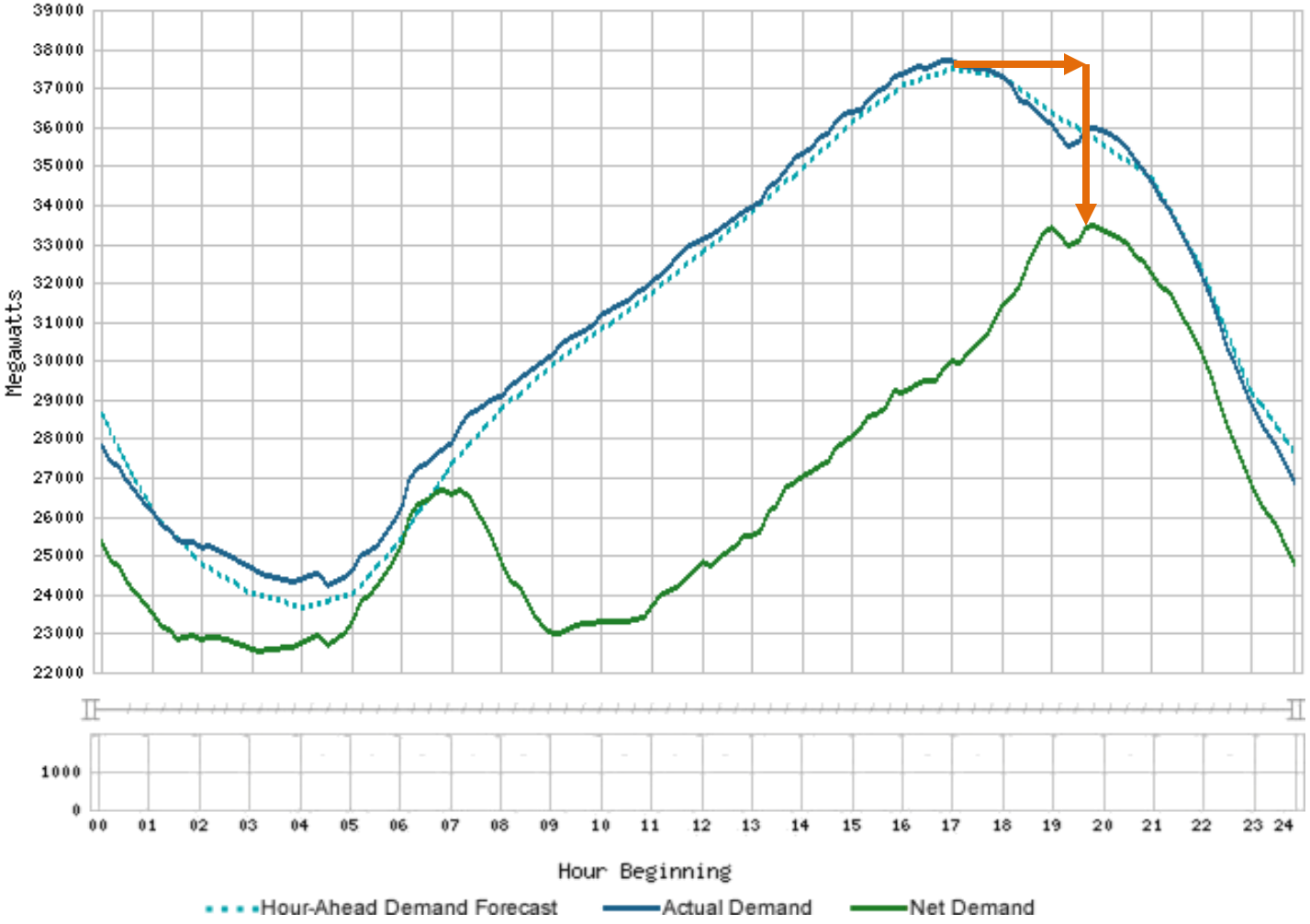


Imports trend

Unspecified imported energy, in megawatts, scheduled for delivery within the ISO balancing authority.



Solar & wind production drive a shift in use pattern for conventional resources on peak demand days



Expected future state of CAISO Resource Mix

Looking Towards a Carbon Free Grid by 2045

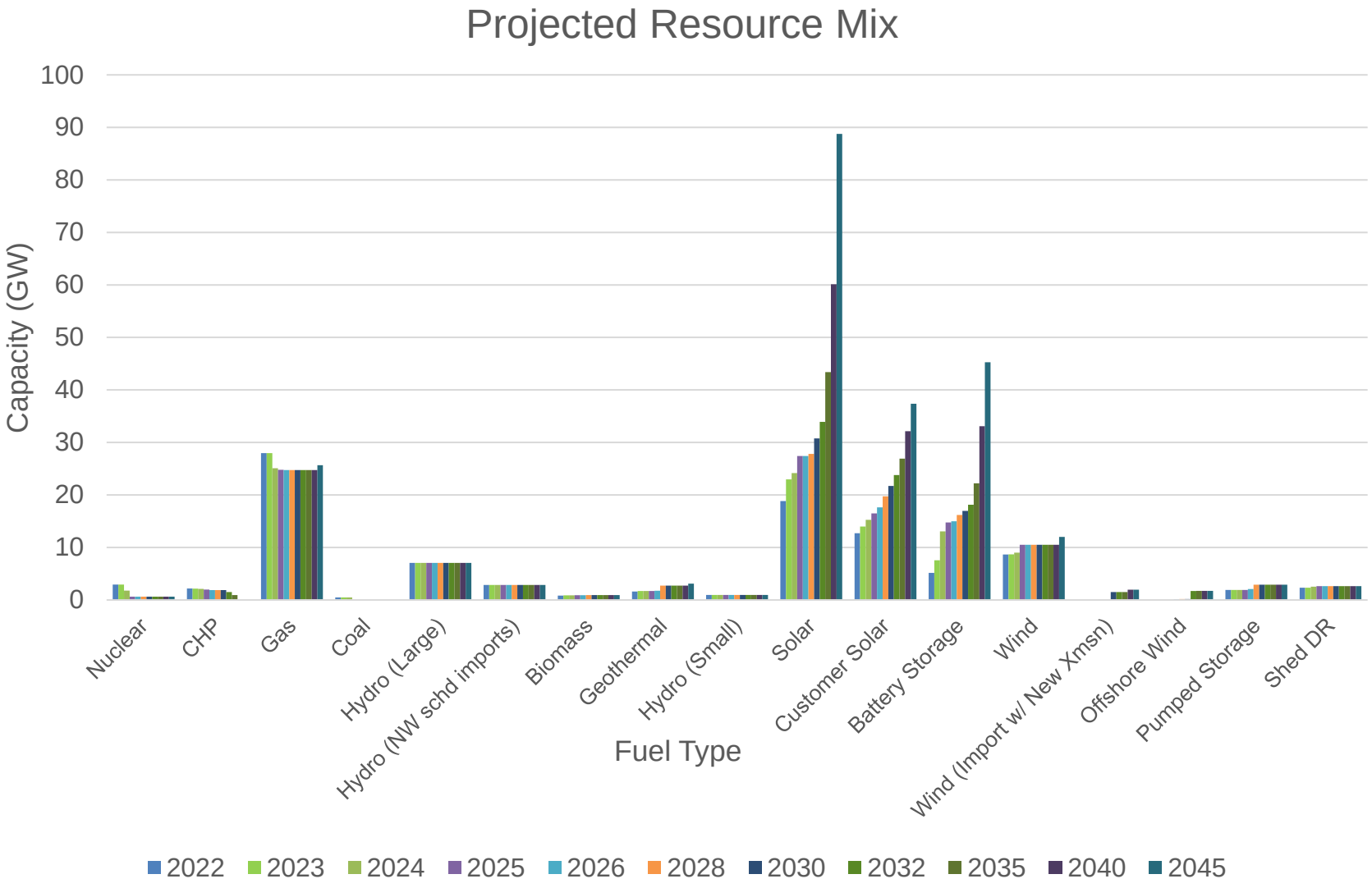
Senate Bill 100 — Moves California to 60% renewable resources and 100% zero-carbon energy by 2045

- Title “100 Percent Clean Energy Act of 2018”
- Increases the Renewables Portfolio Standard (RPS) requirement from 50% by 2030 to 60%
- Creates State policy of planning to meet all retail electricity supply with a mix of RPS-eligible and zero-carbon resources by 31 December 2045

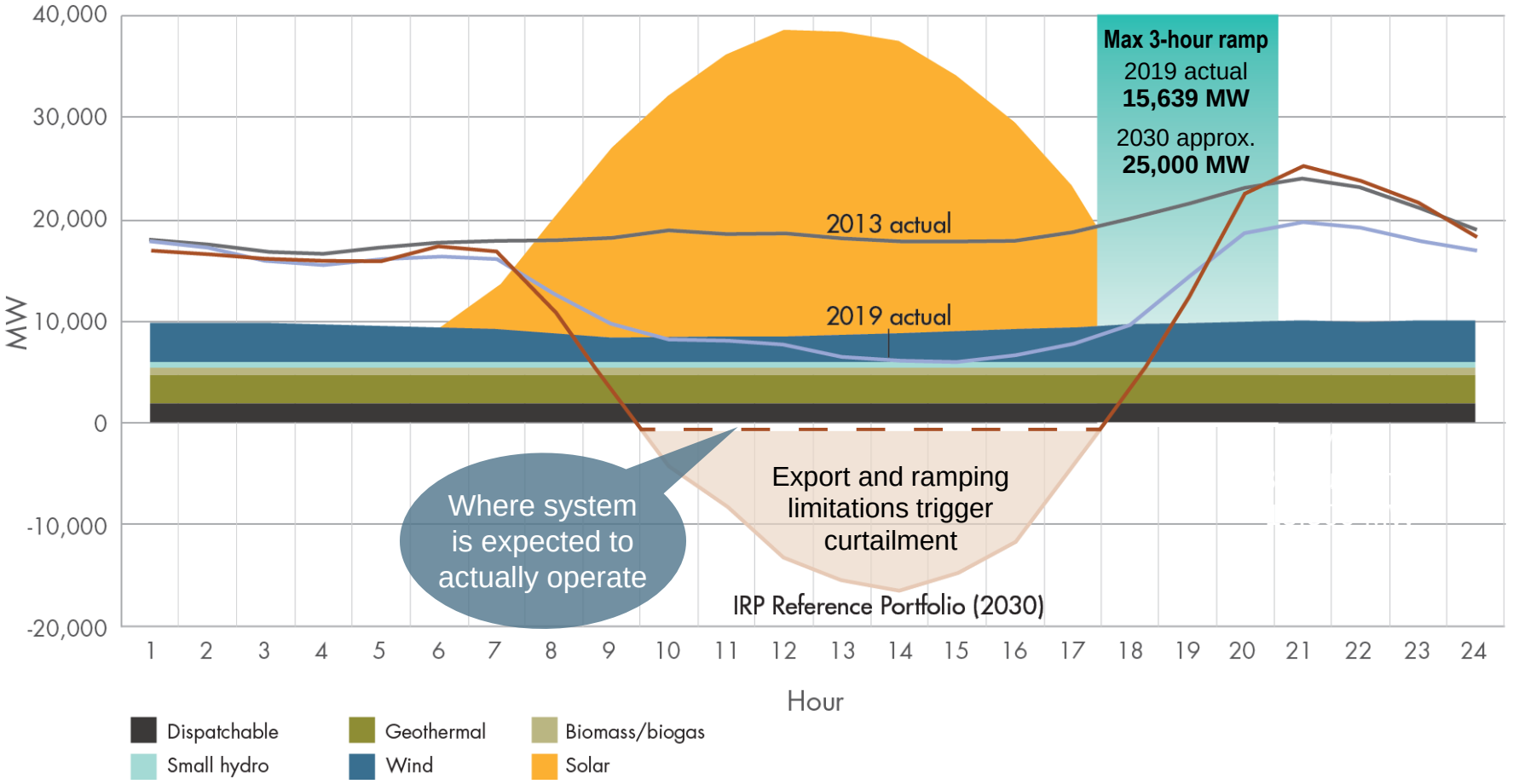
Achieving 100% Clean Electricity in California
2021 SB100 Joint Agency Report Summary

Note: https://ww2.arb.ca.gov/sites/default/files/2021-11/CEC-sp22-electricity-ws-11-02-21.pdf

IRP – 2021 Preferred System Plan



By 2030, solar is expected to contribute to increasing ramping needs



Primary drivers motivating market reforms

- **Increased resource and load variability** - Enhance the day-ahead market and extend to EIM entities to leverage regional diversity to provide benefits across the West

- **New and emerging technologies** - Refine market products, rules, modeling, and system tools to integrate new technologies to replace operational attributes provided by the gas-fired fleet

- **Resource sufficiency** - comprehensively reform resource adequacy requirements to align with the changing nature of resources and tightening supply conditions across the west

Resource Adequacy Reforms

- CPUC implementing “Slice of Day” RA reforms to address net peak load and reliability across a 24-hour period
  - Refocuses the RA program to recognize potential energy limitations for a fleet with deep storage penetration

- CAISO looking for opportunities to harmonize programs with the CPUC and enhance market mechanisms to address net peak needs and supply uncertainty.

Questions/Comments